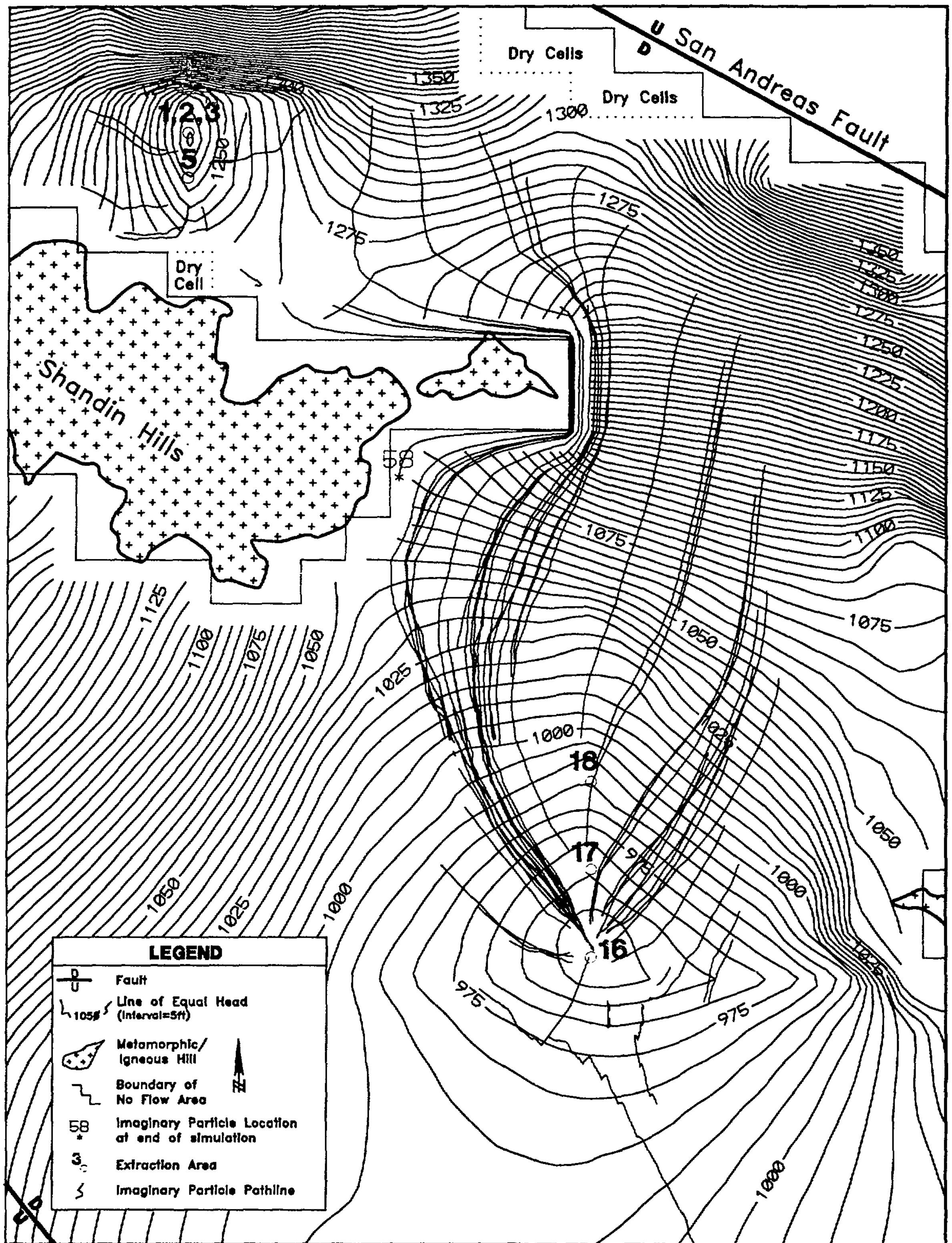

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FIGURE 13-8
HEAD CONTOUR AND PATHLINE PLOT FOR EXTRACTION SCENARIO NO. 8, LAYER 1 (UPPER AQUIFER)

0 1000' 2000'
SCALE IN FEET

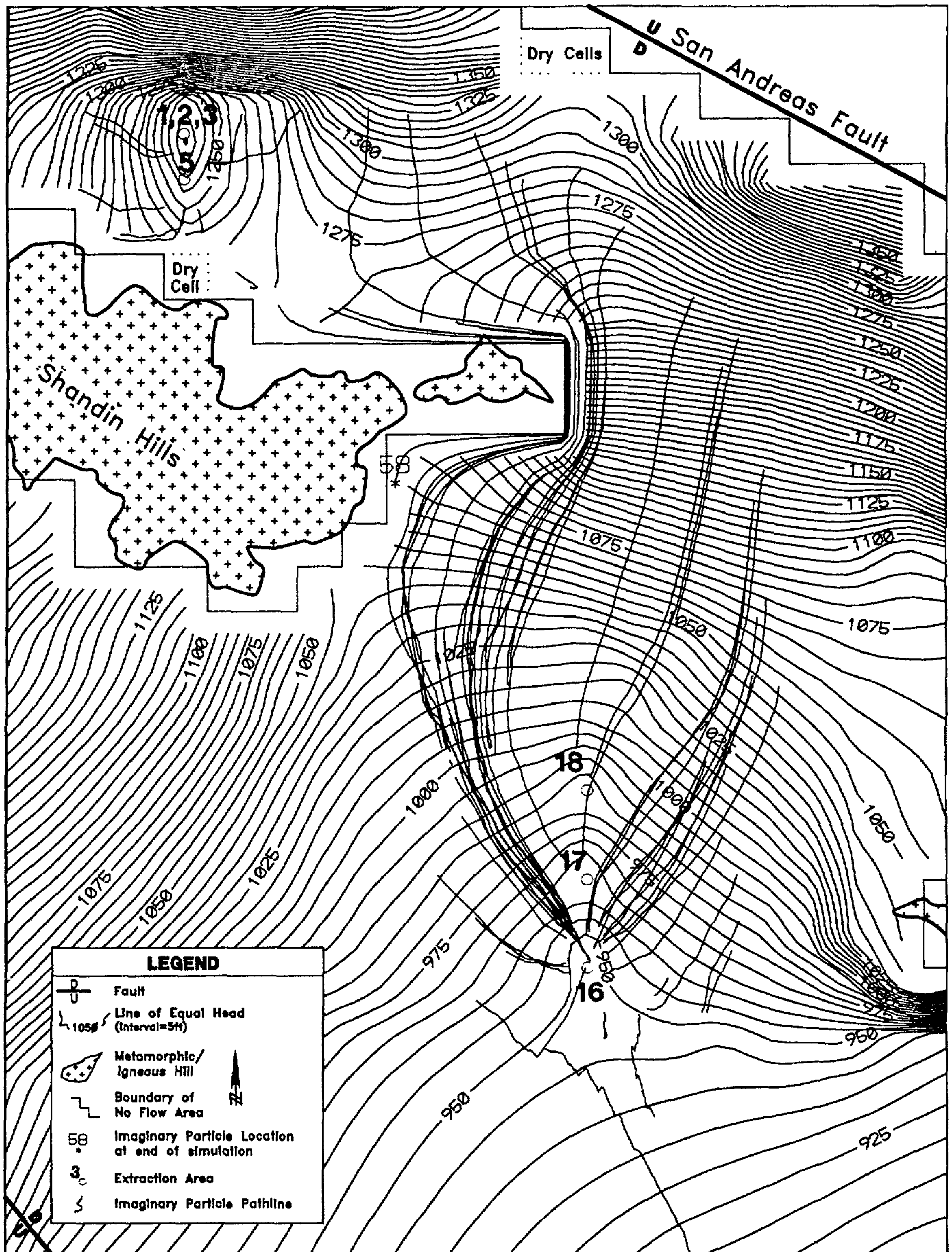

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FIGURE 13-9
HEAD CONTOUR AND PATHLINE PLOT FOR EXTRACTION SCENARIO NO. 8, LAYER 2 (LOWER AQUIFER)

SCALE IN FEET

Table 13-3

Summary of Extraction Scenario No. 8

Extraction Area	Approximate Location	Pumping Rate (gpm)	Remediation Time (yrs)	
			Best-case[a]	Worst-case[b]
Centerline of Newmark Plume				
16	100' E/of Mt. View Ave.; 250' N/of 18th St.	4,000		
17	100' E/of Mt. View Ave.; 200' N/of Highland Ave.	3,000		
18	on Mt. View Ave.; 150' N/of 27th St.	3,000		
Newmark wellfield of Newmark Plume				
Newmark 1[c]	NE corner of "A" St. & Western Ave.	0 to 2,910[d]	Remediation from Newmark wellfield to edge of Newmark plume	
Newmark 2[c]	175' S/of Reservoir Dr.; 40' W/of Magnolia Dr.			
Newmark 3[c]	95' N/of 42nd St.; 280' E/of Western Ave.			
Newmark 4[c]	65' S/of Reservoir Dr.; 50' E/of Western Ave.	0 to 1,585[e]		
5	450' W/of 4th St.; 500' S/of 42nd St.	800	60.8	167.3

[a] Remediation time is calculated using the average velocity of the groundwater.
[b] Remediation time is calculated using the average velocity of PCE in the groundwater.
[c] Existing water-supply well.
[d] Total pumping rate range for Newmark 1,2 & 3 for 1986 through 1990 was used in the 35-year simulation.
[e] Pumping rate range for Newmark 4 for 1986 through 1990 was used in the 35-year simulation.

13.2 EVALUATION OF ALTERNATIVES

This section describes the nine criteria used to evaluate the remaining alternatives. Each alternative is evaluated against all of the identified criteria except state and community acceptance. These final two criteria, state and community acceptance, will be addressed after comments are received on the Proposed Plan.

The nine criteria are:

- Overall Protection of Human Health and the Environment
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
- Long-term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume
- Short-term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

The nine criteria used for this analysis evaluate detailed aspects of effectiveness, implementability and cost which were evaluated during screening of both technologies and alternatives. The first two criteria (overall protection of human health and the environment, and compliance with ARARs) must be met by any alternative to be eligible for selection. The next five criteria (long-term effectiveness and permanence; reduction of toxicity, mobility or volume; short-term effectiveness; implementability; and cost) are considered to be the tradeoff criteria during selection. The final two criteria (state and community acceptance) will be evaluated after the preferred alternative is identified, the proposed plan is developed and comments are received from concerned agencies and the public. Each of the nine criteria are discussed below:

Overall Protection of Human Health and the Environment: Protectiveness is the primary requirement that CERCLA remedial actions must meet. A remedy is protective if it adequately eliminates, reduces, or controls all current and potential risks posed from each exposure pathway identified at the site through the use of treatment, engineering, or institutional controls. This criterion is met if the Remedial Action Objectives, identified in Section 8.0, are achieved through implementation of the remedial action alternative.

Compliance with ARARs: Compliance with ARARs is one of the statutory requirements to determine whether an alternative will meet the applicable federal and State requirements. Compliance with chemical-specific (e.g., maximum contaminant levels), location-specific (e.g., preservation of historic sites), and action-specific (e.g., RCRA minimum technology standards) ARARs are addressed, where applicable..

EPA has identified MCLs as preliminary ARARs for this RI/FS and is currently completing a more detailed list of ARARs that may include additional performance standards. This FS may require revision when the ARARs are complete.

Long-term Effectiveness and Permanence: This criterion assesses the potential risk remaining at the site after the response actions have been completed. The focus is on the extent and effectiveness of the controls that may be required to manage risk, therefore, the two elements that are considered are: magnitude of residual risk; and adequacy and reliability of controls.

The magnitude of residual risk measures the risk remaining from untreated waste or treatment residuals when the remedial activities are complete.

The adequacy and reliability of controls addresses the adequacy, suitability, and long-term reliability of any controls that are necessary to manage treatment residuals or untreated wastes that remain at the site. These elements are measured: to ensure that any exposure to human and environmental receptors is within protective levels; assess the potential need to replace technical components of the alternative; and outline the risks involved if the remedial action needs replacement.

Reduction of Toxicity, Mobility, or Volume: This criterion assesses the permanence and degree that an alternative reduces toxicity, mobility or volume of contamination. Aspects of this criterion may consist of the amount of treated material, expected levels of contaminant reduction, reversibility of the treatment, and the amount of treatment residuals.

This criterion is satisfied when treatment reduces the contamination through destruction, or irreversibly reduces the contaminant mass, mobility, or volume.

Short-term Effectiveness: This criterion assesses the alternative's effects on human health and the environment during the construction and implementation phase until the Remedial Action Objectives are achieved. This includes short-term impacts on the neighboring community, workers, and the environment.

An estimate of the time required to achieve the Remedial Action Objectives is discussed in Section 13.1 and is the same for all alternatives except for No Action which will not achieve the objectives.

Implementability: Implementability measures the technical feasibility, administrative feasibility and the availability of services and materials, to construct, operate, and maintain the remedial alternative.

Technical feasibility refers to: technical unknowns during construction and operation, reliability of an alternative during implementation, ease of implementing necessary additional remedial actions, and ability to effectively monitor the alternative.

Administrative feasibility refers to the required actions to coordinate with other offices and agencies to obtain approvals and permits.

Availability of services and materials refers to the availability of treatment, storage and disposal services; the availability of necessary equipment, materials and specialists; and the availability of possible technologies.

Cost: Project costs are divided into four categories: Groundwater Extraction, Treatment Facilities, End Use, and Groundwater Monitoring Wells. The capital and Operation and Maintenance (O&M) costs are determined for each major component within each category. Capital costs are major expenditures for equipment, labor, and materials required to construct and start up the facilities. O&M costs are those costs required to operate the facilities after construction is complete. O&M costs include operating labor, maintenance labor and materials, utility consumption, project and treatment facility analytical services, an equipment replacement contingency, and miscellaneous other costs. The basis for the costs developed for alternatives is presented in Table 13-4.

Capital costs for major components such as the GAC units or stripping towers, tanks, or pumps have been obtained from suppliers of the equipment. Costs for facilities such as the chlorination system have been obtained from standard cost curves as presented in Cost Estimating Software (1986). Percentage of construction costs have been utilized to estimate the cost of elements such as site work or electrical that are generally proportional to the size and complexity of the project. When costs were obtained from cost curves, percentage of construction, or when several quotations were obtained for the same component, engineering experience has been applied to assure the costs conform to recent costs for similar facilities and that the costs presented are representative of the planned facilities. The following percentages are used to estimate the total capital cost: 15 percent of capital cost for contractor overhead and profit (Contractor OH&P), 15 percent of capital cost for engineering design and management activities, and 5 percent for activities related to project administration. Finally, a 20 percent contingency has been applied to the Capital Cost estimate to cover changes in the project scope and design refinements not covered in the suppliers' quotations or the initial plant design.

The cost factors set forth in Table 13-4 form the basis for determining the O&M costs presented in the cost estimate for each alternative. Electrical utility costs have been estimated based on typical energy requirements for each major component such as pumps or an ozone generator. Material costs are based on the usage estimates presented in the design criteria table for each alternative and the unit cost factors presented in Table 13-4. Unit cost factors have been obtained from vendors and are based on 1992 quotations. The labor associated with each O&M cost component have been taken from the above referenced cost curves and engineering experience with similar facilities. Based on the above, a total annual operating cost is estimated for each alternative. The present worth of the O&M component for each alternative over the 30-year period is determined using a 5 percent discount rate before taxes and after inflation in accordance with EPA Guidance (EPA 1988).

Table 13-4

COST BASIS

Cost Factors	Discount Rate = 5 percent per annum Number of Years = 30
Operational Factors	Operational Hours = 24 hrs/day Operational Days = 365 days/yr
Unit Cost Factors	Electricity = $0.10/kwh Diesel Fuel = $1.50/gallon Natural Gas = $0.0066/cubic foot Labor = $45/hour Building Energy Use = $60 kwh/square foot/year kwh/lb Ozone = 11
Material/Chemical Costs	GAC (liquid phase)[1] = $1.00/lb GAC (vapor phase)[1] = $2.00/lb Hydrogen Peroxide = $0.70/lb Chlorine = $0.20/lb UV Lamp = $60/lamp
Cost Not Included in Estimates	Land Procurement Power Transmission Line Construction Finished Water Pump Station Municipal System Improvements All Samples Analyzed at No Cost Using EPA CLP

Note: [1] Costs are for new carbon.

The total present worth is the sum of the 30-year present worth O&M and the initial capital cost.

After the present worth of each alternative has been determined, individual costs are evaluated through a sensitivity analysis. The cost impact of variations in major cost elements for which there are uncertainties associated are assessed. The elements considered in the sensitivity analysis are detailed in the discussion of cost for each alternative.

State Acceptance: This criterion reflects the statutory requirement to provide for State involvement. State comments may be addressed appropriately during the development of the FS, although formal State comments usually will not be received until the State has reviewed the draft RI/FS and the draft Proposed Plan prior to the public comment period.

Community Acceptance: This criterion refers to community comments on the remedial alternatives under consideration, where community is broadly defined to include all interested parties.

Table 13-5 summarizes general response actions and estimated costs for all alternatives evaluated in this section.

13.2.1 Alternative 1: No Action (Monitoring)

The No Action alternative includes quarterly sampling and water level monitoring of 15 existing monitor wells, four new (to be installed) monitoring wells, and 26 existing municipal wells. Because this alternative does not provide a permanent remedy, it is subject to the 1986 CERCLA amendments which, in part, require that contamination threats be reviewed every five years.

Under this alternative, four additional monitoring wells would be constructed approximately near the head of the plume and in front of Anthill production wells. Each of the wells would have a total depth of 1,200 feet. These wells would be developed and then sampled quarterly along with the existing monitoring and municipal wells.

Table 13-5

SUMMARY OF ALTERNATIVES
Newmark

General Response Action	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Groundwater Extraction	▪ None	▪ Extract 4000 gpm groundwater from 4 wells at Newmark Wellfield ▪ Extract 8000 gpm groundwater from 4 wells at plume front	▪ Same as Alternative 2	▪ Same as Alternative 2	▪ Same as Alternative 2
Treatment	▪ None	▪ Treat VOCs with aqueous GAC	▪ Treat VOCs with air stripping and vapor phase GAC off-gas treatment	▪ Advanced oxidation (Ozone/Peroxide)	▪ Same as Alternative 2
Disposal	▪ Monitor groundwater quality	▪ Convey treated effluent to City Distribution System	▪ Same as Alternative 2	▪ Same as Alternative 2	▪ Injection wells
CRITERIA	**EVALUATION**				
Overall Protection of Human Health and the Environment	▪ Does not reduce risks to human health or the environment. Usually implemented with other alternatives	▪ Adequately eliminates contaminants through treatment	▪ Same as Alternative 2	▪ Same as Alternative 2	▪ Same as Alternative 2
Compliance with ARARs	▪ Does not satisfy ARARs	▪ Meets ARARs.	▪ Same as Alternative 2	▪ Bench and pilot studies required to determine if ARARs are able to be met	▪ Same as Alternative 2
Long-term Effectiveness and Permanence	▪ Does not provide long-term effectiveness	▪ Residual risk is low ▪ Adequate and reliable system	▪ Same as Alternative 2	▪ Residual risk is low ▪ Treatability studies required to determine the adequacy and reliability of the system	▪ Same as Alternative 2
Reduction of Toxicity, Mobility, or Volume	▪ No reduction of toxicity, mobility, or volume	▪ Irreversibly reduces contaminant toxicity, mobility and volume	▪ Same as Alternative 2	▪ Same as Alternative 2	▪ Same as Alternative 2
Short-term Effectiveness	▪ Provides short-term effectiveness	▪ High degree of short-term effectiveness	▪ Same as Alternative 2	▪ Provides satisfactory short-term effectiveness	▪ Same as Alternative 2

Table 13-5 (Cont'd.)

SUMMARY OF ALTERNATIVES
Newmark

General Response Action	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
CRITERIA (Cont'd.)	**EVALUATION (Cont'd.)**				
Implementability	▪ Easy to implement ▪ Reliable and effective for monitoring contamination	▪ Technically and administratively implementable	▪ Standard to construct, reliably operate, and maintain ▪ Treatment units require regular monitoring of control systems	▪ Innovative remedial approach that is undemonstrated for expected flow rates ▪ Requires personnel training to operate systems	▪ Same as Alternative 2
APPROXIMATE ESTIMATED COSTS					
Total Capital Cost Annual O&M Total Present Worth	$1.1 million $0.2 million $3.5 million	$12.3 million $2.5 million $49.9 million	$11.0 million $2.4 million $47.9 million	$16.8 million $2.9 million $61.0 million	$16.3 million $2.1 million $48.1 million

Well head treatment is considered for the 16 wells in the Antil facility (Section 6.4.3) if these wells were contaminated due to the migration of Newmark plume. For the cost estimation, the treatment system for each well head is assumed to consist of temporary filters, granular activated carbon unit, effluent tank, backwash tank and chlorination system. Using the pumpage data for Antil facility wells (Appendix J), a design flow of 1000 gpm is estimated for each well. The design criteria for this case is similar to the North Plant in Alternative 2. The estimated capital cost of a well head treatment system for each well is approximately $448,000. Thus the total capital cost of well head treatment systems for 16 Antil facility wells is approximately $7.17 million.

Overall Protection of Human Health and the Environment - This remedial alternative does not reduce risks to human health or the environment because contaminants cannot be eliminated, reduced, or controlled by monitoring alone. Additional short-term and long-term threats may result from continued migration of the contaminant plume.

This alternative is usually implemented in conjunction with other alternatives to enhance protective measures.

Compliance with ARARs - The No Action alternative does not remove nor contain contaminated groundwater. Because potential for human exposure to contamination is not eliminated, it does not provide protection for human health by reducing contaminant levels to MCLs, and therefore does not satisfy ARARs.

Long-Term Effectiveness and Permanence - The No Action alternative does not provide long-term effectiveness and permanence.

This alternative has a high magnitude of residual risk due to potential long-term risks to human health and the environment resulting from contaminant migration to groundwater.

Although this alternative is effective and reliable in monitoring contaminant migration from the site, it has a low measure of adequacy and reliability of control because it allows continued migration of contaminants into groundwater.

Reduction of Toxicity, Mobility, or Volume - This alternative does not reduce toxicity, mobility, or volume of contaminants because there is no containment, removal, treatment, or disposal of contaminated groundwater.

Short-Term Effectiveness - The No Action alternative does provide short-term effectiveness.

There are no construction or implementation phases associated with this alternative that would be a risk to human health and the environment. Workers responsible for sample collection and site inspections would require proper personal protection equipment.

In terms of the time until remedial objectives are met, this alternative will not accomplish meeting those objectives.

Implementability - This alternative is reliable and effective in monitoring contamination and is easy to implement technically, but is administratively poor.

Administratively, long-term management would be associated with this alternative since contamination remains unchanged. Quarterly sampling requires some administrative and regulatory attention. Necessary services, equipment, and personnel are available.

Cost - Table 13-6 presents the costs associated with Alternative 1. The total present worth cost of this alternative is approximately $3.5 million (capital cost - approximately $1.1 million, annual O&M cost - approximately $0.2 million).

Table 13-6

ESTIMATED COST - ALTERNATIVE 1

Description	Quantity	Unit	Material	Total Cost Labor	Total	Material	Total Cost Labor	Total
CAPITAL COST								
Groundwater Monitoring Wells								
Wells	4800	lf	$40	$95	$135	$192,000	$456,000	$648,000
Well Head Completion	4	ea	6,000	3,000	9,000	24,000	12,000	36,000
Subtotal								$684,000
TOTAL CONSTRUCTION COST								**684,000**
Contractor OH & P		15%						102,600
Engineering & Const. Management		15%						102,600
Administration		5%						34,200
Contingency		20%						136,800
TOTAL CAPITAL COST								**$1,060,200**
ANNUAL O&M COST								
Groundwater Monitoring								
Existing Monitoring Wells				$0	$4,000	$92,000		$96,000
Existing Municipal/Calif. EPA Wells				0	2,000	34,000		36,000
New Monitoring Wells				0	500	23,500		24,000
Subtotal								$156,000
TOTAL ANNUAL O&M COST								$156,000
PRESENT WORTH OF ANNUAL O&M COST								$2,398,102
TOTAL PRESENT WORTH								$3,458,302

13.2.2 Alternative 2: Aqueous GAC with Municipal End Use

This alternative uses groundwater extraction wells placed ahead of the leading edge of the plume and within the plume near the existing Newmark Wellfield Treatment Plant. The extracted groundwater would be transmitted through underground piping to an aqueous GAC treatment plant. The treated groundwater would be discharged into the municipal water supply system. Design criteria for this alternative are presented in Table 13-7.

Groundwater Extraction

Four plume wells, with a capacity of 2,000 gpm each, spaced at approximately 850 feet, would be constructed in the vicinity of 14th Street, between Arrowhead Avenue and Waterman Avenue. The wells would be drilled to an approximate depth of 1,100 feet and would withdraw water from the two water producing aquifers in this area. Line shaft vertical turbine pumps would be installed in each well. Where possible the motors and equipment would be installed above ground. The water collection system would consist of 16-inch and 24-inch diameter pipe buried in the local streets. A 30-inch diameter, buried, transmission pipeline would convey the collected raw water from the extraction well area to the proposed South Treatment Plant located in the vicinity of 6th Street, east of Waterman Avenue. The proposed pipeline route is shown on Figure 13-10.

An additional 800 gpm well would be drilled in the Newmark Wellfield area. With the addition of this well to the existing municipal wells, the total groundwater pumping capacity in the area would be 4,000 gpm. The well would be drilled to an approximate depth of 500 feet and withdraw water from the single aquifer in the area. A line shaft vertical turbine pump would be installed above ground. A 12-inch diameter, buried, transmission pipeline would be constructed to convey the raw water to the proposed North Treatment Plant. The proposed pipeline route is as shown on Figure 13-11.

Table 13-7

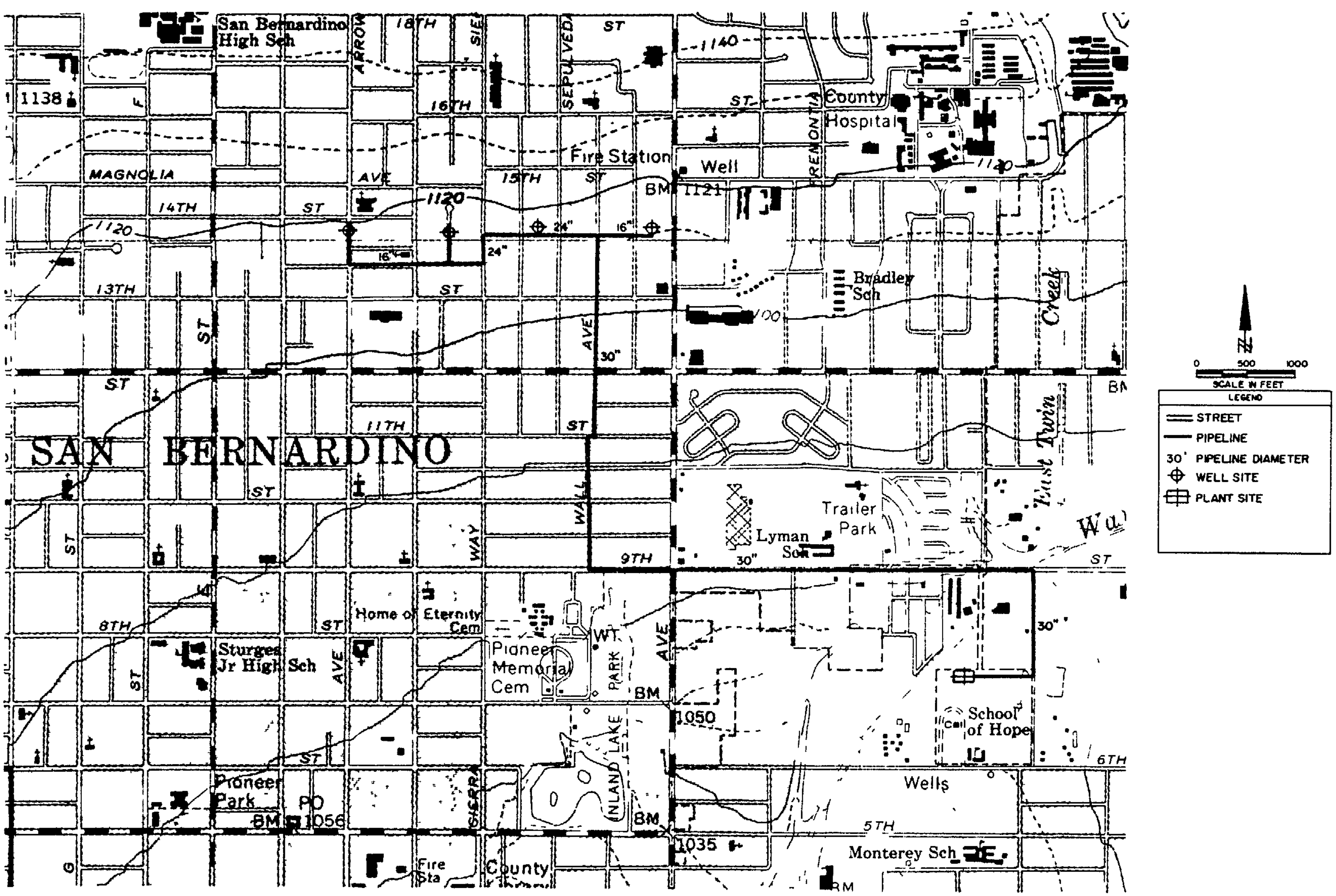
DESIGN CRITERIA
ALTERNATIVE 2

Item	Units	South Plant	North Plant
GROUNDWATER EXTRACTION SYSTEM			
1. Extraction Wells			4 existing
Number	each	4	1 additional
Capacity (each)	gpm	2,000	800
Total Capacity	gpm	8,000	4,000
Estimated Well Depth	ft	1,100	500
Approximate Depth to Groundwater	ft	100	230
Casing Diameter	inch	20	16
Total Pumping Head	ft	152	350
2. Raw Water Transmission System			
30-inch Diameter	L.F.	12,000	--
24-inch Diameter	L.F.	1,200	--
16-inch Diameter	L.F.	1,200	--
12-inch Diameter	L.F.	--	2,500
TREATMENT SYSTEM			
1. *Plant Capacity*	gpm	8,000	4,000
	MGD	11.5	5.8
Influent Concentration			
Tetrachloroethylene (PCE)	μg/L	75	75
Trichloroethylene (TCE)	μg/L	10	10
Effluent Concentration			
Tetrachloroethylene (PCE)	μg/L	2	2
Trichloroethylene (TCE)	μg/L	2	2
2. Treatment			
Type: Granular Activated Carbon			
Number of Units (pairs)	each	8	4
Unit Operation	--	series	series
Plant Operation		parallel	parallel
Flow Per Unit	gpm	1,000	1,000
Total Vessels	each	16	8
Carbon Volume (each)	ft^3	715	715
Carbon Volume (each pair)	ft^3	1,430	1,430
Empty Bed Contact Time (EBCT) (each	min	5.3	5.3
vessel)	min	10.7	10.7
EBCT (per pair)			
EBCT (one pair off line)	min	4.7	4.0
Each Vessel	min	9.4	8.0
Per Pair	lb	20,000	20,000
Carbon Per Vessel	lb	320,000	160,000
Total Plant Carbon	days	292	292
Estimated Carbon Life (per vessel)	lb	400,000	200,000
Estimated Annual Usage	psi	125	125
ASME Vessel & Pressure Rating			

Table 13-7 (Cont'd.)

DESIGN CRITERIA
ALTERNATIVE 2

Item	Units	South Plant	North Plant
3. Effluent Tank			
Working Capacity	gal (1000)	201	132
Size (Diameter x Height)	ft	48 x 16	38 x 16
Seismic Construction	--	anchored	anchored
4. Disinfection			
Type: Gaseous Chlorine			
Dosage Rate	mg/L	0.5 - 1.0	0.5 - 1.0
	lb/day	48 - 96	24 - 48
Residual	mg/L	0.3 - 0.5	0.3 - 0.5
Unit Size	lb/day	200	100
Control	--	continuous	continuous
Storage Cylinder Size	lb	2,000	2000
Number of Cylinders	each	4	4
5. Backwash System			
Rate	gpm	1,200	1,200
Nominal Time	min	15	15
Tank Size (Diameter x Height)	ft	26 x 8	26 x 8
Tank Working Capacity	gal (1000)	28	28
Tank Seismic Construction	--	anchored	anchored
6. Start Up Filtration			
Type: Bag Filters			
Number of Vessels	each	5	3
Flow per Vessel	gpm	2,000	2,000
Bags per Vessel	each	10	10
END USE			
1. Municipal System			
Pumps: Vertical Turbine			
Number	each	4	3
Total Pumping Rate	gpm	8,000	4,000
Pump Rate (each)	gpm	2,700	2,000



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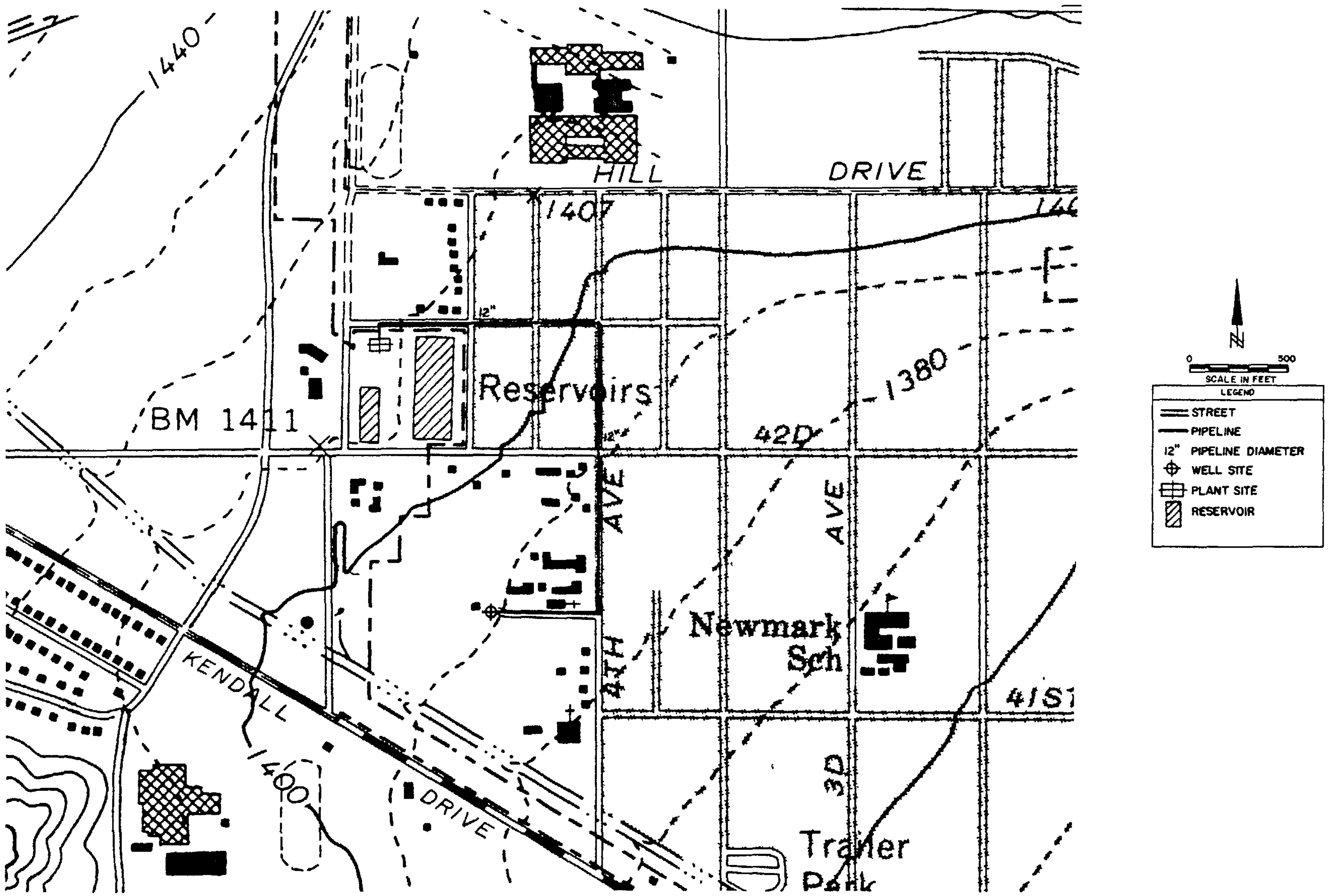
SOUTH PLANT
EXTRACTION WELL LOCATION
& PIPELINE ROUTE

FIGURE 13-10



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NORTH PLANT
EXTRACTION WELL NO 5
LOCATION & PIPELINE ROUTE

FIGURE 13-11

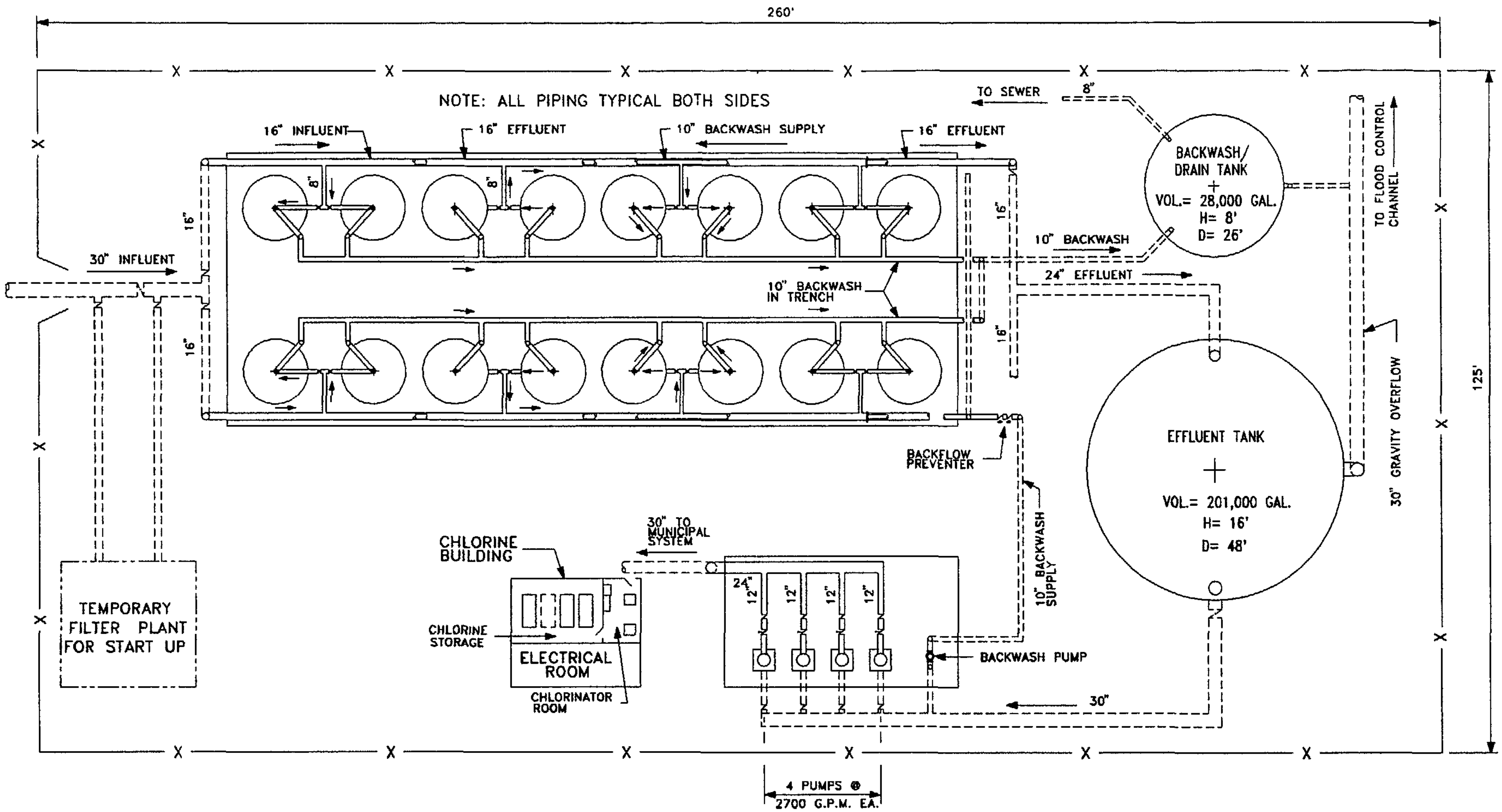

FIGURE 13-12
ALTERNATIVE 2
AQUEOUS GAC WITH MUNICIPAL END USE
SOUTH PLANT

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Treatment System

The proposed South Treatment Plant is shown on Figure 13-12 and the proposed North Treatment Plant is shown as Figure 13-13.

The treatment process consists of pairs of GAC vessels operating in parallel to treat the total plant flow. Table 13-7 provides the specific plant design data. The operation would be similar for each pair of vessels. Raw water enters the first (lead) vessel from a common header where initial contaminant removal takes place, then flows to the second (lag) vessel where final contaminant removal (to meet discharge requirements) is accomplished. Water samples would be routinely taken from piping following the lead tank. When the effluent contaminant level from the lead vessel reaches approximately 90 percent of the raw water contamination level, carbon in the lead vessel would be replaced. While the lead vessel's effluent contamination is increasing, the lag vessel would be removing the remainder of the contaminant load. After replacement of the spent carbon in the lead vessel the flow sequence would be reversed with the partially used second vessel functioning as the new lead vessel. The vessel pairs come complete with all valving and piping required to direct the flow into the series operation mode and change the lead and lag vessel configuration.

Effluent System. Finished water would be discharged from the lag vessel to a common header which conveys the water to an effluent tank. The effluent tank would act as a balancing clearwell and forebay for the municipal pumps. It would be equipped with level sensors to control the operation of the effluent pumps. It would also provide clean water storage to backwash the carbon vessels.

Disinfection. The water processed by the treatment system is not expected to require disinfection. However, a chlorination system is planned to provide a chlorine residual in the water discharged to the municipal system. The system would consist of chlorine regulators, tank scales, automatic switch over units, and continuous chlorine residual analyzers to assure a constant residual. Chlorine would be delivered to, and stored in, standard 1-ton cylinders. The chlorination system would be housed in its own building with separate storage and chlorination rooms. Leak detection, reduced pressure principle room ventilators, and scrubber units would be provided for safety in case a chlorine leak occurs.

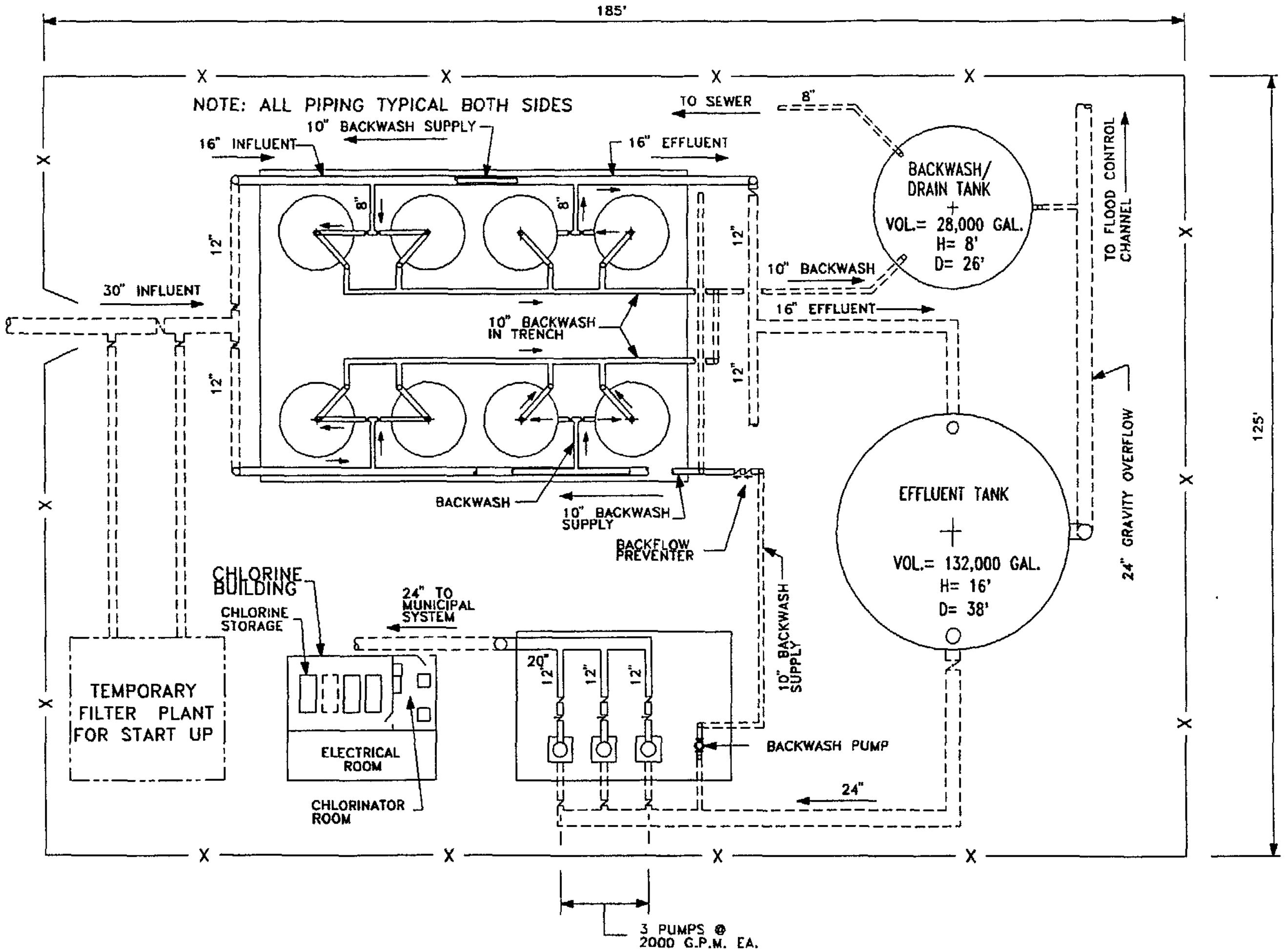

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FIGURE 13-13
ALTERNATIVE 2
AQUEOUS GAC WITH MUNICIPAL END USE
NORTH PLANT

Backwash System. Besides the ability to control influent and effluent piping operations, the system is also capable via piping and valving to direct clean backwash to each of the carbon units and wash water to a common disposal header. Finished water is piped to the bottom of each vessel and flows upward through the carbon, thus backwashing the carbon bed. The wash water then flows to a backwash holding tank where it is discharged at a constant rate to the sanitary sewer system. The backwash tank is capable of accommodating the high volume, high flow rate surge required to clean the units. A rinse cycle, that re-seats the carbon and removes fine materials would also be applied before the units are placed back on line. The backwash cycle would be initiated manually when a pressure buildup, indicating plugging of the carbon beds by suspended solids, is observed in any vessel.

Start-Up Filtration. At the well development and plant start-up stage there would be an increased solids loading on the plant. During this time, temporary pre-filtration would be provided at the head of the plant. The filters would consist of disposable bag-type filters. Once the wells are producing water with a low suspended solids concentration the pre-filtration plant would be removed.

End Use

This alternative would supply a treated, disinfected water suitable for use by the local municipality. The South Plant Pump Station would consist of four pumps sized to pump 8,000 gpm with three pumps operating in parallel. The fourth pump would act as a standby. The North Plant Pump Station would consist of three pumps capable of pumping 4,000 gpm with two pumps operating and one pump as standby.

Should the municipal system not be capable of receiving all of the water being treated due to equipment failure or low municipal water use, the effluent tank would be equipped with an overflow pipeline. The effluent pipeline would be sized to discharge the entire 8,000 gpm flow to the municipal water system.

Groundwater Monitoring Wells

Four monitoring wells would installed downgradient of extraction wells in the plume front area. The location and detail of the plume front extraction wells can be found in Subsection 13.2.2. The wells would be drilled to a total depth of 1,200 feet. Three additional monitoring wells would be installed downgradient of Newmark Wellfield. These wells will have a depth of 600 feet. The purpose of the monitoring wells is to monitor the effectiveness of the groundwater treatment.

Newmark Wellfield Treatment Plant (North Plant) and Plume Front Treatment Plant (South Plant) conceptual site locations are presented on Figures 13-10 and 13-11, respectively.

Overall Protection of Human Health and the Environment - Aqueous GAC treatment with municipal disposal alternative does protect human health and the environment. The Remedial Action Objective to reduce ingestion of contaminated groundwater to below MCLs is achieved.

This alternative is a treatment control which transfers contaminants from groundwater to activated carbon by adsorption in aqueous carbon treatment vessels. Off-site carbon regeneration or incineration serves to contain and destroy contaminants adsorbed during remediation.

This alternative reduces potential risk posed to human health by treating groundwater before it enters the municipal water system. A potential risk of exposure through the installation of groundwater wells for irrigation would still exist. This risk is considered to be low because irrigation waters typically are not injected. The low levels of VOCs in the groundwater would volatilize during irrigation so residuals in injected crops would be low.

Compliance with ARARs - Alternative 2 does comply with preliminary ARARs in that it treats contaminated groundwater to MCLs.

This alternative requires transportation of spent carbon to a commercial regeneration facility, which would require compliance with standards applicable to generators of hazardous waste under RCRA, and with federal and State Department of Transportation (DOT) regulations governing the transportation of hazardous wastes. These are expected to be easily met.

The regeneration facility accepting spent carbon is required to be in compliance with applicable federal and State permit requirements relevant to hazardous waste disposal facilities. These are also expected to be met.

Long-Term Effectiveness and Permanence - The aqueous GAC with municipal disposal alternative does provide long-term effectiveness and permanence.

Magnitude of residual risk after remediation is low because groundwater contaminants are extracted and removed from the site. The only residuals remaining after treatment are VOCs that have combined with organic carbon in the soil. This alternative is adequate and suitable to treat the volume of groundwater expected to be encountered at Newmark. It is also a proven and reliable technology for treating groundwater that does not result in untreated wastes remaining on site.

There is limited exposure to human and environmental receptors that are within protective levels, mainly during spent carbon handling. Potential need to replace the alternative or components of the alternative is low because of its proven capability.

Reduction of Toxicity, Mobility, or Volume - This alternative permanently and irreversibly reduces contaminant toxicity, mobility, and volume through carbon adsorption and regeneration. It would reduce levels of contamination to meet Remedial Action Objectives.

This alternative meets the CERCLA/SARA preference for prior treatment before off-site disposal of hazardous waste by treating spent carbon before disposal. Spent carbon would be incinerated, thereby destroying contaminants, before disposal of residual ash.

Short-Term Effectiveness - The aqueous GAC with municipal disposal alternative would provide a high degree of short-term effectiveness.

During the construction and implementation phases of this alternative, there are not expected to be significant potential health threats to area residents or the environment. Personnel responsible for handling spent carbon would need to be properly protected (via personal protective equipment) against dermal contact and inhalation of carbon dust. Risk of exposure during carbon exchange is low because spent carbon is transferred in hoses as a slurry.

Implementability - The aqueous GAC with municipal disposal alternative are implementable, both technically and administratively.

The aqueous GAC technology is demonstrated and commercially available. During construction and operation, significant technical unknowns are not expected, other than standard details associated with large process construction projects.

This alternative is reliable to operate and maintain during implementation, and additional remedial actions are not expected to be difficult to implement. Monitoring of the alternative is considered to be easily accomplished at the extraction well, GAC unit, and regeneration facility.

Administratively, permits for on-site treatment, off-site spent carbon transport, and approval for treated water disposal into the municipal supply are required and are expected to be appropriately obtained.

Availability of regeneration facilities, necessary equipment, and personnel is expected to be high.

Cost - Table 13-8 presents the costs associated with the South Plant and Table 13-9 presents the North Plant costs. The total project cost for this alternative is obtained by adding the cost of North and South Plants. The total project cost for Alternative 2 (capital cost - approximately $12.3 million, annual O&M cost - approximately $2.5 million, and total present worth - approximately $49.9 million) is presented in Table 13-5.

Table 13-8

ESTIMATED COST - ALTERNATIVE 2: SOUTH PLANT

Description	Quantity	Unit	Unit Cost Material	Unit Cost Labor	Unit Cost Total	Total Cost Material	Total Cost Labor	Total Cost Total
CAPITAL COST								
Groundwater Extraction								
Extraction Wells	4400	lf	$60	$140	$200	$264,000	$616,000	$880,000
Extraction Pumps	4	ea	46,000	9,000	55,000	184,000	36,000	220,000
Pipeline	14400	lf	50	58	108	720,000	835,200	1,555,200
Subtotal								$2,435,200
Treatment Facilities								
Temporary Filters	5	ea	$10,000	$1,200	$11,200	$50,000	$6,000	$56,000
GAC Units	8	pairs	186,000	5,600	191,600	1,488,000	44,800	1,532,800
Effluent Tank	1	ea	70,000	30,500	100,500	70,000	30,500	100,500
Backwash Tank	1	ea	27,000	8,000	35,000	27,000	8,000	35,000
Backwash Pump	1	ea	18,000	6,000	24,000	18,000	6,000	24,000
Chlorination System	1	ls	43,000	7,000	50,000	43,000	7,000	50,000
Building	480	sf	50	20	70	24,000	9,600	33,600
Structural	1	ls			170,190			170,190
Site Work & Yard Piping		ls			200,209			200,209
Site Electrical		ls			77,572			77,572
Subtotal								$2,279,871

Table 13-8 (Cont'd.)

ESTIMATED COST - ALTERNATIVE 2: SOUTH PLANT

Description	Quantity	Unit	Unit Cost Material	Unit Cost Labor	Unit Cost Total	Total Cost Material	Total Cost Labor	Total Cost Total
CAPITAL COST (Cont.)								
End Use								
Booster Pumps	4	ea	$68,800	$34,000	$102,800	$275,200	$136,000	$411,200
Subtotal								$411,200
G/W Monitoring Wells								
Wells	4800	lf	$40	$95	$135	$192,000	$456,000	$648,000
Well Head Completion	4	ea	6,000	3,000	9,000	24,000	12,000	36,000
Subtotal								$684,000
TOTAL CONSTRUCTION COST								$5,810,271
Contractor OH & P		15%						871,541
Engineering & Const. Management		15%						871,541
Administration		5%						290,514
Contingency		20%						1,162,054
TOTAL CAPITAL COST								$9,005,921

Table 13-8 (Cont'd.)

ESTIMATED COST - ALTERNATIVE 2: SOUTH PLANT

Description	Utilities	Materials	Labor	Total
ANNUAL O&M COST				
Groundwater Extraction				
Extraction Wells	$282,500	$4,875	$34,500	$321,875
Pipeline	0	20,000	9,360	29,360
Subtotal				$351,235
Treatment Facilities				
GAC Units	$0	$400,000	$27,000	$427,000
Backwash Pumps	880	2,440	5,150	8,470
Chlorination System	2,270	9,720	18,000	29,990
Subtotal				$465,460
End Use				
Booster Pumps	$470,850	$3,400	$33,840	$508,090
Subtotal				$508,090
Groundwater Monitoring				
Monitoring Wells	0	6,500	149,500	$156,000
Subtotal				$156,000
TOTAL ANNUAL O&M COST				$1,480,785
PRESENT WORTH OF ANNUAL O&M COST				$22,763,295
TOTAL PRESENT WORTH				$31,769,216

Table 13-9

ESTIMATED COST - ALTERNATIVE 2: NORTH PLANT

Description	Quantity	Unit	Unit Cost Material	Unit Cost Labor	Unit Cost Total	Total Cost Material	Total Cost Labor	Total Cost Total
CAPITAL COST								
Groundwater Extraction								
Extraction Wells	500	lf	$60	$140	$200	$30,000	$70,000	$100,000
Extraction Pumps	1	ea	36,000	9,000	45,000	36,000	9,000	45,000
Pipeline	2500	lf	36	44	80	90,000	110,000	200,000
Subtotal								$300,000
Treatment Facilities								
Temporary Filters	3	ea	$8,000	$1,200	$9,200	$24,000	$3,600	$27,600
GAC Units	4	pairs	186,000	5,600	191,600	744,000	22,400	766,400
Effluent Tank	1	ea	51,300	24,700	76,000	51,300	24,700	76,000
Backwash Tank	1	ea	27,000	8,000	35,000	27,000	8,000	35,000
Backwash Pump	1	ea	18,000	6,000	24,000	18,000	6,000	24,000
Chlorination System	1	ls	30,700	5,000	35,700	30,700	5,000	35,700
Building	640	sf	50	20	70	32,000	12,800	44,800
Structural	1	ls			92,220			92,220
Site Work & Yard Piping		ls			110,172			110,172
Site Electrical		ls			45,177			45,177
Subtotal								$1,257,069

Table 13-9 (Cont'd.)

ESTIMATED COST - ALTERNATIVE 2: NORTH PLANT

Description	Quantity	Unit	Unit Cost Material	Unit Cost Labor	Unit Cost Total	Total Cost Material	Total Cost Labor	Total Cost Total
CAPITAL COST (Cont.)								
End Use								
Booster Pumps	3	ea	$68,000	$34,000	$102,000	$204,000	$102,000	$306,000
Subtotal								$306,000
G/W Monitoring Wells								
Wells	1800	lf	$35	$80	$115	$63,000	$144,000	207,000
Well Head Completion	3	ea	6,000	3,000	9,000	18,000	9,000	27,000
Subtotal								234,000
TOTAL CONSTRUCTION COST								$2,097,069
Contractor OH & P		15%						314,560
Engr. & Const. Management		15%						314,560
Administration		5%						104,853
Contingency		20%						419,414
TOTAL CAPITAL COST								$3,250,456

Table 13-9 (Cont'd.)

ESTIMATED COST - ALTERNATIVE 2: NORTH PLANT

Description	Utilities	Materials	Labor	Total
ANNUAL O&M COST				
Groundwater Extraction				
Extraction Wells	$329,600	$2,400	$18,000	$350,000
Pipeline		2,500	1,800	4,300
Subtotal				$354,300
Treatment Facilities				
GAC Units		$200,000	$15,000	$215,000
Backwash Pumps	$560	1,550	4,750	6,860
Chlorination System	1,470	6,220	16,000	23,690
Subtotal				$245,550
End Use				
Booster Pumps	$329,600	$1,880	$28,300	$359,780
Subtotal				$359,780
Groundwater Monitoring	$0	$500	$7,500	$8,000
Subtotal				$8,000
TOTAL ANNUAL O&M COST				$967,630
PRESENT WORTH OF O&M COST				$14,874,845
TOTAL PRESENT COST				$18,125,301

13.2.3 Alternative 3: Air Stripping with Off-Gas Treatment and Municipal End Use

This alternative uses groundwater extraction wells placed ahead of the leading edge of the plume and within the plume near the existing Newmark Treatment Plant. The extracted groundwater would be transmitted through buried piping to the air stripping treatment plant. The treated groundwater is then discharged into the municipal water supply system. Design criteria for this alternative are presented in Table 13-10.

Groundwater Extraction

Groundwater extraction process is the same as in Alternative 2 and consists of four 2,000 gpm wells located ahead of the plume and one new 800 gpm well in the Newmark Wellfield. The water collection and transmission and treatment plant sites are the same as Alternative 2.**Treatment System**

The proposed South Treatment Plant is shown on Figure 13-14 and the proposed North Treatment Plant is shown on Figure 13-15.

Air Stripping with Off-gas Treatment. The treatment process consists of air stripping towers operating in parallel to treat the total plant flow. For specific plant design information refer to Table 13-10. The operation would be the same for each tower. The air stripping process employs a countercurrent contacting of air with water in a vertical packed tower. The tower is filled with packing material that enhances the contact of the water with the air. Water from the extraction wells is pumped directly to the top of the tower where an orifice hole type distribution tray assures even distribution of the water across the tower packing and prevents channeling. Raw water cascades downward through the tower packing as the air passes upward through the packing. The water is collected in a sump at the bottom of the tower and pumped into the effluent tank. Air for the towers is supplied from centrifugal type fan blowers located within the same room, adjacent to the towers. The blowers are sized such that there is always one blower in reserve if one of the primary units should fail. Air is conveyed to the bottom of the towers through above ground ducting.

Table 13-10

DESIGN CRITERIA
ALTERNATIVE 3

Item	Units	South Plant	North Plant
GROUNDWATER EXTRACTION SYSTEM			
1. Extraction Wells			4 existing
Number	each	4	1 additional
Capacity (each)	gpm	2,000	800
Total Capacity	gpm	8,000	4,000
Estimated Well Depth	ft	1,100	500
Approximate Depth to Groundwater	ft	100	230
Casing Diameter	inch	20	16
Total Pumping Head	ft	152	350
2. Raw Water Transmission System			
30-inch Diameter	L.F.	12,000	--
24-inch Diameter	L.F.	1,200	--
16-inch Diameter	L.F.	1,200	--
12-inch Diameter	L.F.	--	2,500
TREATMENT SYSTEM			
1. Plant Capacity	gpm	8,000	4,000
	MGD	11.5	5.8
Influent Concentration			
Tetrachloroethylene (PCE)	μg/L	75	75
Trichloroethylene (TCE)	μg/L	10	10
Effluent Concentration			
Tetrachloroethylene (PCE)	μg/L	2	2
Trichloroethylene (PCE)	μg/L	2	2
2. Treatment			
Type: Air Stripping with Emission Control			
Number of Air Stripping Towers			
Operation	each	3	2
Flow Per Unit	--	parallel	parallel
Flow Per Unit (one unit off line)	gpm	2,700	2,000
Diameter (each unit)	gpm	4,000	4,000
Packing Height (each unit)	ft	12	12
Number of GAC Units	ft	15	15
Carbon Weight (each GAC unit)	each	3	2
Carbon Weight (total)	lb	18,000	18,000
Estimated Annual Carbon Usage	lb	54,000	36,000
Air Flow (each blower)	lb	35,000	17,500
Air Flow (total)	cfm	8,000	6,000
Air/Water Ratio	cfm	24,000	12,000
Hydraulic Loading Rate (normal operation)	--	22:1	22:1
Hydraulic Loading Rate (one unit off line)	gpm/ft^2	23.6	17.7
	gpm/ft^3	35.4	35.4

Table 13-10 (Cont'd.)

DESIGN CRITERIA
ALTERNATIVE 3

Item	Units	South Plant	North Plant
3. Disinfection			
Type: Gaseous Chlorine			
Dosage Rate	mg/L	0.5 - 1.0	0.5 - 1.0
	lb/day	48 - 96	24 - 48
Residual	mg/L	0.3 - 0.5	0.3 - 0.5
Unit Size	lb/day	200	100
Control	--	continuous	continuous
Storage Cylinder Size	lb	2,000	2,000
Number of Cylinders	each	4	4
4. Start-Up Filtration			
Type: Bag Filters			
Number of Vessels	each	5	3
Flow per Vessel	gpm	2,000	2,000
Bags per Vessel	each	10	10
END USE			
1. Municipal System			
Pumps: Vertical Turbine			
Number	each	4	3
Total Pumping Rate	gpm	8,000	4,000
Pump Rate (each)	gpm	2,700	2,000

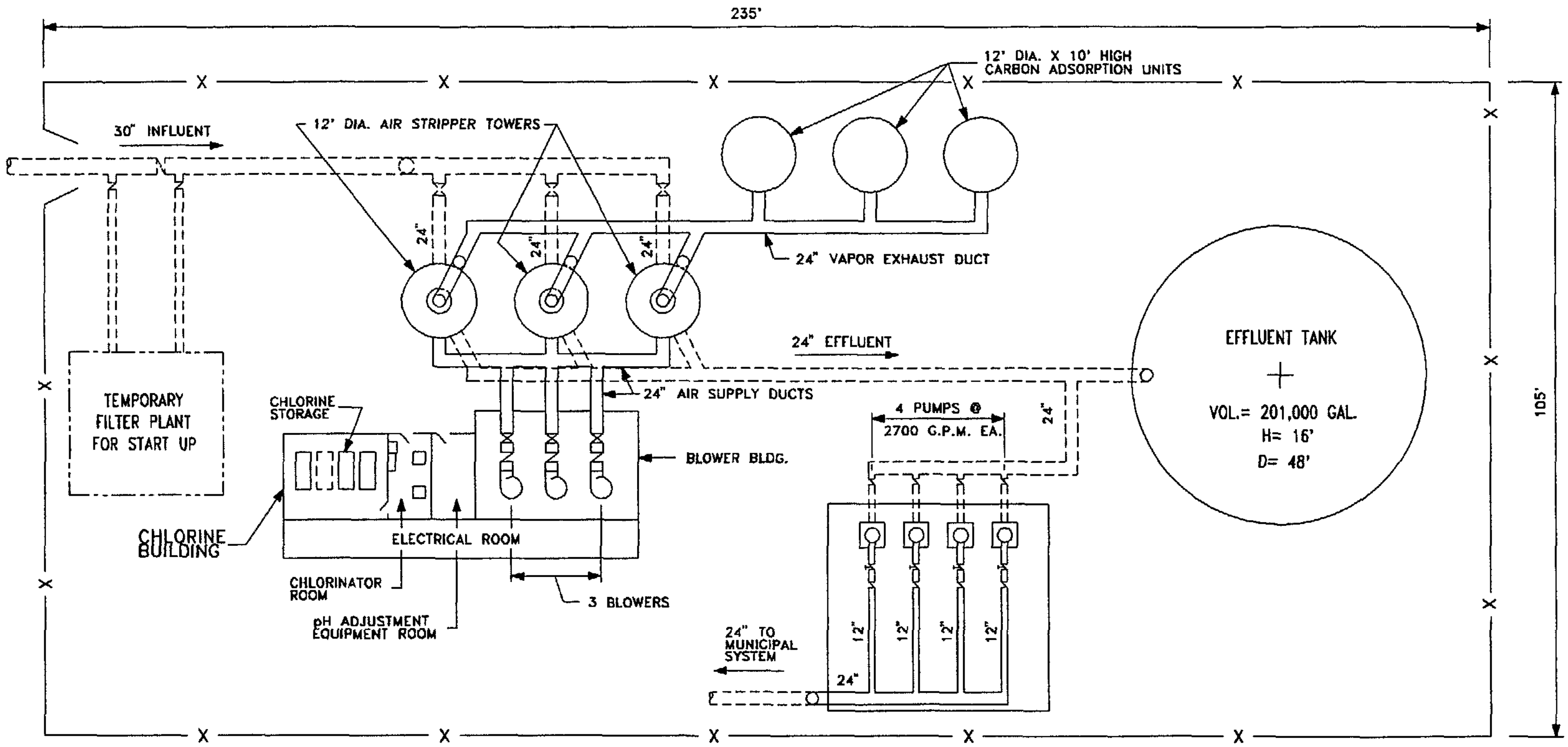

FIGURE 13-14
ALTERNATIVE 3
AIR STRIPPING WITH VAPOR PHASE GAC
OFF-GAS TREATMENT AND MUNICIPAL END USE
SOUTH PLANT

Newmark Groundwater Superfund Site
Newmark Operable Unit RI/FS Report

ARCS, EPA REGIONS IX & X

WA NO 54-10-9LJ5

URS CONSULTANTS
2710 GATEWAY OAKS DR.
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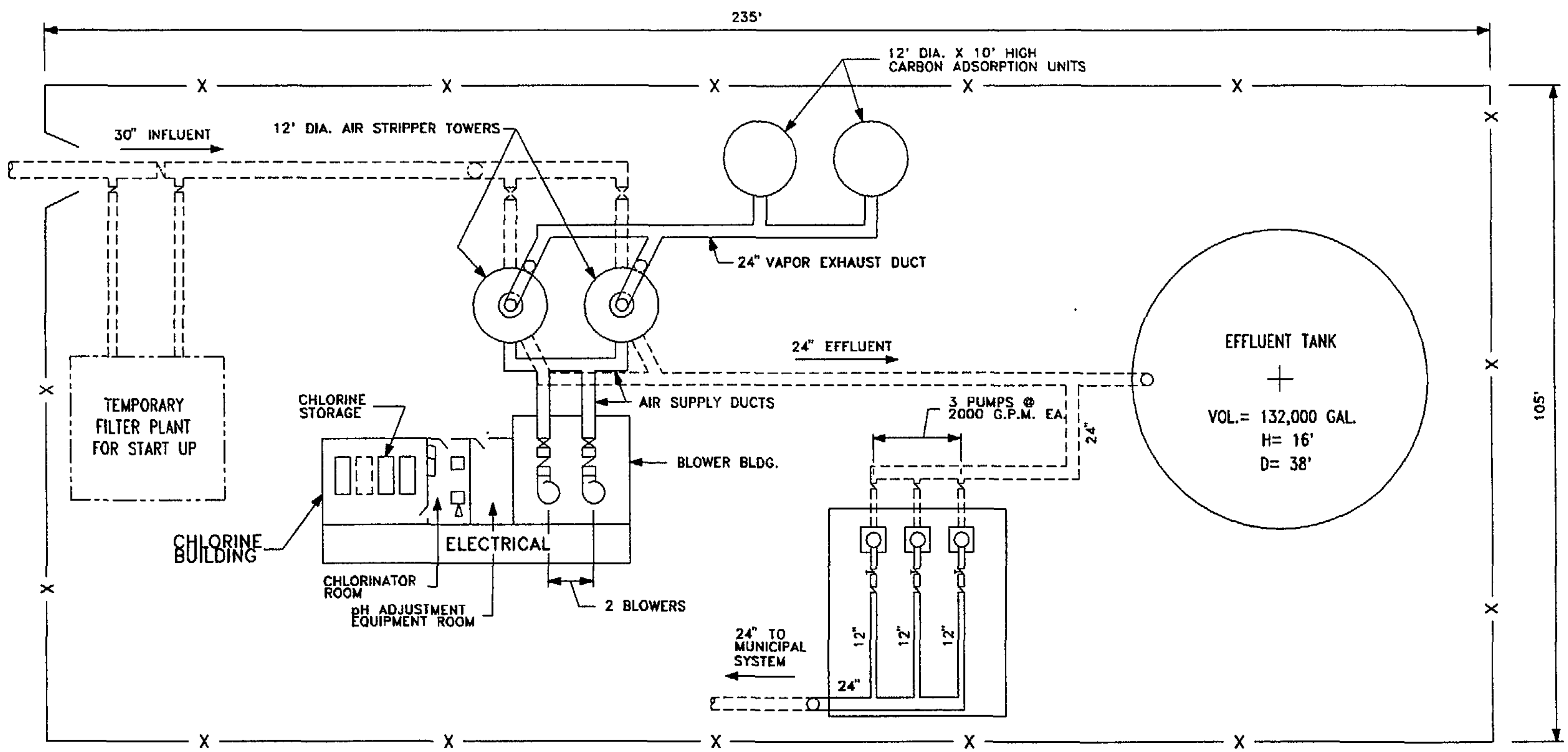

FIGURE 13-15
ALTERNATIVE 3
AIR STRIPPING WITH VAPOR PHASE GAC OFF-GAS TREATMENT AND MUNICIPAL END USE
NORTH PLANT

Newmark Groundwater Superfund Site
Newmark Operable Unit RI/FS Report

ARCS, EPA REGIONS IX & X — WA NO. 64-10-9LJ5

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Water vapor passes through a mist eliminator and is collected at the top of the tower and discharged into an exhaust duct. The exhaust system contains a heater/dryer through which the air passes on its way to the carbon adsorption units. The carbon units remove the organic compounds before discharging the air to the atmosphere. The carbon units are also designed to operate in parallel with adequate reserve capacity to allow one unit to be taken off line and still treat all of the vapor from the air stripping towers.

Effluent System. The effluent system operates the same as for Alternative 2. Water from the tower sump discharges into a common header that conveys the water to the effluent tank. The effluent tank serves as a clearwell and forebay for the municipal pump station.

Disinfection. The disinfection system operates the same as for Alternative 2. Water discharged from the tower sump would be chlorinated to provide a residual for the municipal water system.

Start-Up Filtration. The operation of the pre-filtration plant would be the same as Alternative 2. The bag filters would operate during plant start-up and well development.

End Use

The end use of the water is the same as Alternative 2. Water would be supplied to the municipal pump station.

Groundwater Monitoring Wells

The groundwater monitoring wells in this alternative are the same as those discussed in Alternative 2. Four monitoring wells would be installed downgradient of extraction wells in the plume front area. The depth of these wells would be 1,200 feet. Also, three additional monitoring wells with a depth of 600 feet would be installed downgradient of Newmark Wellfield.

Overall Protection of Human Health and the Environment - The air stripping with vapor phase GAC off-gas treatment and municipal disposal alternative would protect human health and the environment.

This alternative is a treatment control which transfers contaminants from groundwater to vapor phase in the air stripper, and from vapor phase to vapor phase carbon by adsorption in carbon vessels. Off-site regeneration serves to destroy contaminants in the same process as aqueous carbon, which eliminates risks posed to human health and the environment.

Using the municipal supply for disposal increases protection by reducing contamination levels to drinking water standards after the associated treatment.

Compliance with ARARs - This alternative meets the CERCLA/ SARA preference for off-site disposal with prior treatment to permanently reduce contaminant toxicity, mobility, or volume.

This evaluation is similar to that of Alternative 2, as air stripping with vapor phase GAC off-gas treatment and municipal disposal is also expected to meet transportation standards applicable to generators of hazardous waste under RCRA, and with federal and State DOT regulations governing the transportation of hazardous waste.

The regeneration facility accepting spent carbon is required to be in compliance with, and is expected to meet, applicable federal and State permit requirements relevant to hazardous waste disposal facilities.

Long-Term Effectiveness and Permanence - The air stripping with vapor phase GAC off-gas treatment and municipal disposal alternative would provide long-term effectiveness.

As discussed in the evaluation of Alternative 2, the magnitude of residual risk is low, and the alternative is adequate and suitable to treat the volume of groundwater expected to be encountered at Newmark. It is a proven and reliable method for treating groundwater that does not result in untreated wastes remaining on-site except VOCs adsorbed to organic carbon in the soil.

Reduction of Toxicity, Mobility, or Volume - This alternative permanently and irreversibly reduces contaminant toxicity, mobility, and volume through air stripping, carbon adsorption and carbon regeneration. It is expected to reduce levels of contamination to meet Remedial Action Objectives, and also to meet air contaminant discharge requirements.

Short-Term Effectiveness - The air stripping with vapor phase GAC off-gas treatment and municipal disposal alternative provides short-term effectiveness.

Similar to the discussion of Alternative 2, there are not expected to be potential health threats to area residents or the environment during the construction and implementation phases of this alternative. Personnel responsible for handling spent carbon would need to have proper personal protective equipment. This alternative differs from aqueous GAC in that vapor phase carbon is changed in a dry state. Dust control and air monitoring in work areas would be required.

Implementability - The air stripping with vapor phase GAC off-gas treatment and municipal disposal alternative is implementable.

Similar to the discussion for Alternative 2, the technologies are demonstrated and commercially available, and significant technical unknowns are not expected during construction and operation.

This alternative is considered to be reliable to operate and maintain during implementation, and additional remedial actions are not expected to be difficult to implement. Regular monitoring of the air stripper and vapor phase GAC systems is required to maintain consistent operation. Other monitoring is considered to be easily accomplished at the extraction well and regeneration facility.

Administrative feasibility is similar to that of Alternative 2, with permits for on-site treatment, off-site spent carbon transport, and approval for treated water disposal into the municipal supply being required and expected to be appropriately obtained. This alternative would also require an air discharge permit that was not required in Alternative 2.

Availability of regeneration facilities, necessary equipment, and personnel is also expected to be high.

Cost - Table 13-11 presents the costs associated with the South Plant and Table 13-12 presents the North Plant costs. The total project cost for this alternative is obtained by adding the cost of North and South Plants. The total project cost for Alternative 3 (capital cost - approximately \$11.0 million, annual O&M cost - approximately \$2.4 million, and total present worth - approximately \$47.9 million) is presented in Table 13-5.

The San Bernardino Newmark air stripping system consists of two 12 feet diameter air stripping towers, with a total water flow rate of 6,000 gpm. The operational air to water ratio for the towers is 50 to 1, which results in an air flow rate of approximately 20,00 cfm in each tower. At present, the air coming out of the towers is emitted directly to the atmosphere without treatment. Since the proposed extraction of groundwater in the North Plant yields 4,000 gpm, both Newmark air stripping towers must be used to treat the extracted water. It may be possible that one of the towers can be used to treat the entire 4,000 gpm flow. But in this case the hydraulic loading rate would be slightly higher than the typical hydraulic loading rate used in the design of the air strippers. This possibility should be considered in detail during remedial design phase. The air strippers should be operated at a lower air to water ratio of approximately 22 to 1 (see Table 13-10) to optimize treatment. The total air flow rate would be 12,000 cfm (or 6,000 cfm in each tower). The exhaust air will be treated using a vapor phase carbon system (see Table 13-10). With these changes (using both of the existing strippers with two new 6,000 cfm blowers instead of the existing 20,000 cfm blowers), the capital cost for the North Plant is estimated to be \$2.43 million. If the existing air strippers were not used, the capital cost for the North Plant would be \$3.05 million (Table 13-12).

13.2.4 Alternative 4: Advanced Oxidation (Ozone/Peroxide) with Municipal End Use

This alternative uses groundwater extraction wells placed ahead of the leading edge of the plume and within the plume near the existing Newmark Treatment Plant. The extracted groundwater would be transmitted through buried piping to an advanced oxidation treatment plant. The treated groundwater is then discharged into the municipal water supply system.